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EXAMINER	
STREGE, JOHN B	
ART UNIT	**PAPER NUMBER**
2625	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/873,230	Applicant(s) BENESCH ET AL.
	Examiner John B Strege	Art Unit 2625

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12/2/04*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 8-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5 and 8-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

Response to Amendment

1. In response to the Applicant's amendment received on 12/02/04, all requested changes to the claims have been entered. Claims 6-7 have been cancelled and claims 1- 5, and 8-31 are pending.

2. The Applicant argues (page 20) that Chuang (col. 2 lines 12-16) wants to avoid the use of a scanning electron microscope. However this does not mean that Chuang can not use a high resolution apparatus. Chuang in fact discloses a sensor that is able to record the diffraction pattern with a high resolution (col. 10, lines 35-36). Applicant's further arguments with respect to claim1 and 20 have been considered but are moot in view of the new ground(s) of rejection.

DETAILED ACTION

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-5,8-21,23-26, and 28-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chuang et al. USPN 6,137,570 (hereinafter "Chuang") in view of the applicants' admitted prior art, further in view of Kallioniemi et al. *Optical scatterometry of subwavelength diffraction gratings: neural-network approach* (hereinafter "Kallioniemi"), and further in view of Alumot et al. USPN 5,982,921 (hereinafter "Alumot").

Chuang discloses a method and apparatus of using scattered and diffracted light to determine whether a collection of topological features on a semiconductor wafer conform to an expected condition or quality (at least col. 2 lines 24-28). This is done by comparing the measured pattern of a surface (derived from scattering and diffraction) with a corresponding baseline or reference pattern (at least col. 2 lines 28-31). Chuang further recites that these patterns will have a certain signature of variation in intensity (col. 16 lines 57-58). This reference information can be measured data taken from light scattered and diffracted off a surface having a known condition, or from a database that stores a collection of the diffracted and scattered pattern for a plurality of surfaces. Chuang further discloses optics to capture light scattered and diffracted from the topographical features of the substrate surface and directed onto a sensor (col. 3 lines 58-60)(this can be read as registering a plurality of individual structures). Chuang further discloses classifying errors on the surface as evidenced by variations between the comparison results (814 and 822 figure 8), and if there is a significant difference between the current pattern and the baseline then remeasuring the selected region (818 figure 8).

Although Chuang does not explicitly state registering a plurality of individual structures of the test surface to be monitored, it is apparent that this is what is being done as both the diffracted and scattered light are collected simultaneously by a sensor. Furthermore the applicants admit that in the known method of scatterometry the scattered light measurement and the diffraction measurement register and evaluate the

diffraction and interference effects because they are characteristic for the structural variables of a measured surface (page 3 lines 8-24).

Chuang and the applicants admitted prior art are analogous art because they are both from the same field of endeavor of scatterometry.

As Chuang discloses a system for measuring scatter and diffraction it is obvious that it is also simultaneously registering a plurality of individual structures. The motivation for this comes from the applicants' admitted prior art that scattermetry systems perform registration of the plurality of individual structures.

Chuang does not explicitly disclose performing the comparing step and the classifying step by using a neural network having a learning capability.

Kallioniemi discloses that there is a need for inexpensive on-line metrology techniques for the mass production of semiconductor devices that would make possible the real-time adaptation of critical process parameters that influence surface structure (first paragraph of section 1, page 5830). Kallioniemi further discloses that optical scatterometry is a fast, nondestructive alternative in which a diffraction pattern from a grating is measured and subsequently compared with possible grating geometries (second paragraph of section 1). It is then recited that neural networks have been utilized for both categorization of diffractive gratings and quantitative prediction of grating geometries (second paragraph section 1). A procedure is then disclosed in section 2 that uses a neural network within the metrology system. Kallioniemi concludes that a neural network has the potential to be an efficient tool for quantitatively predicting the critical dimensions of sub-wavelength diffraction gratings with high

accuracy and with good tolerance to noise in the input data (second paragraph of section 4, page 5834).

Chuang, the applicants' admitted prior art and Kallioniemi are all analogous art because they are from the same field of endeavor of using scatterometry to analyze a surface.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Chuang, the applicants' admitted prior art and Kallioniemi to use a neural network for performing the comparison and classification steps. The motivation for doing so is that it would be efficient and tolerant to noise and stated by Kallioniemi.

Chuang nor Kallioniemi explicitly disclose further measurement of individual structures of the test specimen surface with a high resolution measuring device for specifying a quality of the test specimen surface and for providing a further reference signature. It should be noted that Chuang discloses that the sensor is able to record the diffraction pattern with a high resolution (col. 10, lines 35-36).

Alumot discloses an invention for inspecting the surface of articles by using a first phase of optically examining the complete surface of the article at a relatively high speed and with relatively low spatial resolution, and a second phase of optically examining with a relatively high spatial resolution only the suspected location for the presence or absence of a defect therein (stated at least in the abstract). Kallioniemi further discloses that in order to use a neural network the weight coefficients of the interconnections have to be adapted iteratively by use of known input-output data pairs as training material (second paragraph of section 2). Alumot's invention allows for

speeding up the process of inspection by doing a coarse inspection identifying problems at a low resolution and then switching to fine inspection at a higher resolution if necessary (col. 1 line 42 –col. 2 line 25).

Chuang, Kallioniemi, and Alumot are analogous art because they are all from the same field of endeavor of surface inspection of semiconductor devices.

At the time of the invention it would have been obvious to combine Chuang, the applicants' admitted prior art, Kallioniemi, and Alumot to measure individual structures first with a low resolution device and switching to a high resolution device (for example at step 818 of Chuang) for when a significant difference between the reference signature and the measured signature is detected. The motivation for doing this is that it would allow for a much faster process by only carrying out high resolution imaging when a significant difference exists between the current pattern and the baseline. Thus it would have been obvious to one of ordinary skill in the art to combine Chuang, the applicants' admitted prior art, Kallioniemi, and Alumot to obtain the invention as specified in claim 1.

Claim 20 discloses similar limitations to claim 1 except that claim 20 discloses a device in place of a method thus the same arguments given above for the rejection of claim 1 apply equally to claim 20.

Regarding claim 2, Chuang discloses that the surfaces ideally would have identical topologies, but through non-uniform processing, or other fabrication problems have some slight differences in topology, thus forming a nonperiodic pattern (col. 5 lines 17-32).

Regarding claim 3 Chuang does not expressly disclose providing the plurality of individual structures such that the plurality of individual structures form a lattice having different periodicities along different directions.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the system of Chuang for structures that form a lattice having different periodicities along different directions (such as laser semiconductors). One of ordinary skill in the art would have expected Applicant's invention to perform equally well with this because the system does not depend on periodicity or nonperiodicity of the surface. .

Thus, it would have been obvious to modify Chuang to measure structures that form a lattice have different periodicities to obtain the invention as specified in claim 3.

Regarding claims 4-5, as discussed Chuang discloses measuring the diffracted and scattered light of a surface. As discussed an optical sensor detects the light. Light is electromagnetic radiation.

Regarding claims 8-9, Chuang discloses that the wafer 408 is mounted on an X-Y translation stage which moves the wafer surface relative to the incident light beam thus varying the angle of incidence of the light beam (col. 10 lines 15-43). Furthermore Chuang recites that the system performance can be optimized by adjusting the illumination wavelength, polarization, incident angle, and adjusting the analyzing optics (col. 8 lines 51-53).

Regarding claim 10, Chuang discloses that after an error has been detected it may be of interest to classify the error (col. 15 lines 42-55). This includes several different methods of error classification as listed between lines 49-55 of column 15. It is not explicitly disclosed that the test specimen is classified as good or bad, however Examiner declares official notice as it is well known to do so. The motivation for doing this would be to remove defective semiconductors based on the processing.

Regarding claims 11-12, and 15-18 Chuang discloses in figure 11 providing a classification in accordance with various classes to prepare an error classification report. Step 1108 shows comparison analysis of specific process errors. Step 1106 discloses heuristic analysis of specific process errors. These different types of classification are detailed in column 15 line 21 – column 16 line 61.

Regarding claim 23, Chuang discloses that a light source should be chosen with a wavelength appropriate for the features to be evaluated (col. 9 lines 10-11).

Regarding claims 24-25 Chuang discloses a light source with adjustable illumination wavelengths (col. 8 lines 50-67). Chuang further discloses simultaneous illumination of the substrate surface and capturing the scattered and diffracted light (col. 12 lines 23-25). Chuang does not explicitly disclose carrying out the measurements one at a time.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the system of Chuang to carry out measurements one at a time. Applicants have not disclosed how measuring the wavelengths one at a time provides an advantage. Furthermore, one of ordinary skill in the art would have expected Applicant's invention to perform equally well with this because it accounts for various wavelengths. Thus, it would have been obvious to modify Chuang to measure one at a time as a function of wavelength.

Regarding claim 26, as discussed Chuang discloses using different types of light sources which are spectral lamps (col. 9 lines 1-10). Chuang further discloses filters for extracting light (col. 11 lines 23-42).

Regarding claims 28-29, Chuang discloses that the wafer is mounted on an X-Y translation state which moves the wafer surface relative to the light beam (col. 10 lines 15-43).

Regarding claim 30, Chuang discloses a radiation sensor to measure the electromagnetic radiation reflected by the semiconductor device (coll. 8 lines 38-40).

Regarding claims 13-14, Kallioniemi discloses metrology techniques for the mass production of semiconductor devices (first paragraph section 1, page 5830). A semiconductor device is a periodic memory element structure. As discussed above Kallioniemi also discloses nonperiodic structures.

Regarding claim 19, Killioniemi discloses finding the critical dimensions of periodic microstructures.

Regarding claim 21, Kallioniemi discloses on-line metrology techniques for the mass production of semiconductor devices (paragraph 1 of section 1, page 5830).

Regarding claim 31, Kallioniemi discloses determining the dimension of the microstructure based on the diffraction (first paragraph of section 1, page 5830).

5. Claims 22 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chuang et al. USPN 6,137,570 (hereinafter "Chuang") in view of the applicants' admitted prior art, further in view of Kallioniemi et al. *Optical scatterometry of subwavelength diffraction gratings: neural-network approach* (hereinafter "Kallioniemi"),

further in view of Alumot et al. USPN 5,982,921 (hereinafter "Alumot"), and further in view of McNeil et al. USPN 5,703,692 (hereinafter "McNeil").

As discussed above Chuang and the applicants' admitted prior art disclose all of the limitations of claim 1. Chuang further discloses an electromagnetic radiation source providing coherent light (col. 8 lines 66-67), and at least one electromagnetic sensor (col. 8 lines 38-40). The angle of illumination can be chosen to hit the surface at a fixed angle (col.8 lines 50-65) and the detector measures the surface as a function of polarization (col. 9 line 65 – col. 10 line 14). Chuang does not explicitly disclose a rotation apparatus for rotating a polarization of the coherent electromagnetic radiation, however as stated does disclose that the polarization may be varied (col. 8 lines 50-65).

McNeil discloses a convential scatterometer system in figure 1 that provides for a sample rotary stage for rotating the polarization of the radiation.

Chuang, the applicants' admitted prior art, Kallioniemi, Alumot, and McNeil are analogous art because they are all from the same field of endeavor of inspection.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Chuang, the applicants' admitted prior art, and McNeil to provide for a rotation apparatus. The motivation for doing so is that Chuang discloses that the polarization may be varied, and one possible way to do this is the conventional method of rotation disclosed by McNeil. Therefore it would have been obvious to one of ordinary skill in the art to combine Chuang, the applicants' admitted prior art, and McNeil in order to obtain the invention as specified in claim 22.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John B Strege whose telephone number is (703) 305-8679. The examiner can normally be reached on Monday-Friday between the hours of 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on (703) 308-5246. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JS

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